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R-MATRIX ANALYSIS OF THE ^{235}U NEUTRON CROSS SECTIONS*

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The ENDF/B-V representation of the ^{235}U neutron cross sections in the resolved resonance region is unsatisfactory:[1] below 1 eV the cross sections are given by "smooth files" (file 3) rather than by resonance parameters; above 1 eV the single-level formalism used by ENDF/B-V necessitates a structured file 3 contribution consisting of more than 1300 energy points; furthermore, information on level-spins has not been included. Indeed the ENDF/B-V ^{235}U resonance region is based on an analysis done in 1970 for ENDF/B-III[2] and therefore does not include the results of high quality measurements done in the past 18 years. The present paper presents the result of an R-matrix multilevel analysis of recent measurements as well as older data. The analysis also extends the resolved resonance region from its ENDF/B-V upper limit of 81 eV to 110 eV.

The resonance analysis code SAMMY[3] was used to perform a consistent resonance-parameter analysis of several ^{235}U neutron fission and capture cross-section and transmission measurements and of the spin separated data obtained by Moore *et al.*,[4] from an analysis of the polarized neutron polarized target measurements of Keyworth *et al.*[5]

The program SAMMY uses the multilevel R-matrix Reich-Moore formalism and leads to a physically sound representation of the neutron cross sections in the resonance region. The Bayesian approach, which include the direct introduction of experimental uncertainties such as on sample thicknesses, broadening parameters etc., allows the successive incorporation of new data in a consistent manner. The option to search on sample thicknesses, effective sample temperature, and the parameters of the

instrumental resolution function all consistent with predetermined uncertainty limits, leads to realistic parameter uncertainties and covariance matrices. Recent modification of the program SAMMY permits also a consistent Bayesian fit of the spin separated fission data.

The cross sections of ^{235}U up to 110 eV were represented by a set of 260 resonances with two open fission channels in each spin state. The data analyzed are listed in Table 1. Figures 1 and 2 show sample comparisons between the measured data and computations based on the parameters of the analysis.

The present analysis improves on ENDF/B-V because:

1. It utilizes a physically meaningful formalism and represent the data as well or better than ENDF/B-V, without introducing artificial file 3 contributions.
2. It is consistent with the spin separated fission data. This information obtained at great cost through the work of Keyworth, Moore *et al.*[4,5] is ignored in ENDF/B-V.
3. It extends the resolved resonance region down to 10^{-5} and up to 110 eV.
4. The cross sections in the thermal region were made consistent with the values currently proposed by the ENDF/B-VI standard evaluation committee.[6]

The present analysis will be proposed for the ENDF/B-VI ^{235}U resolved resonance range.

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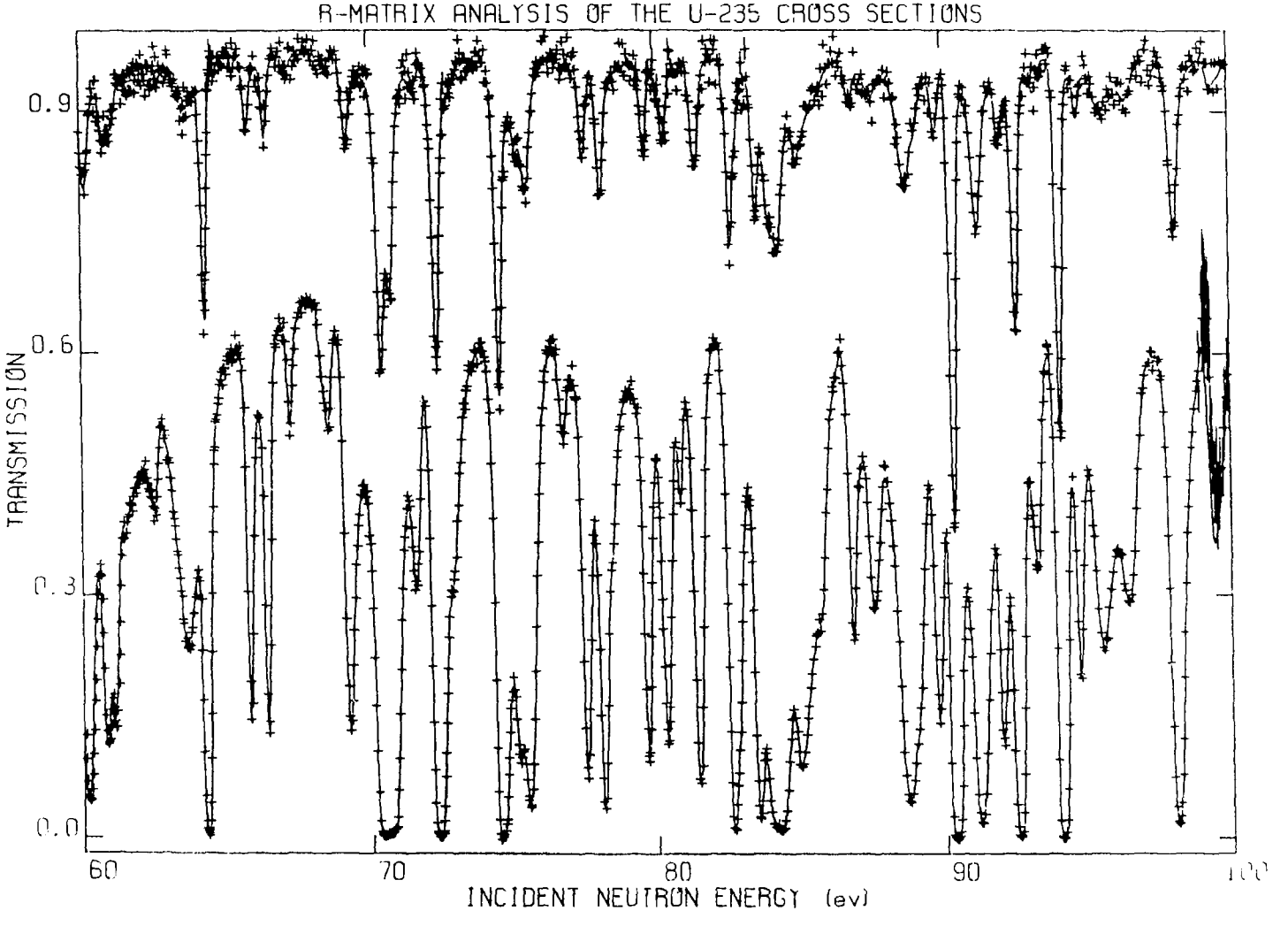
Table 1. Selected measurements of the ^{235}U neutron cross sections

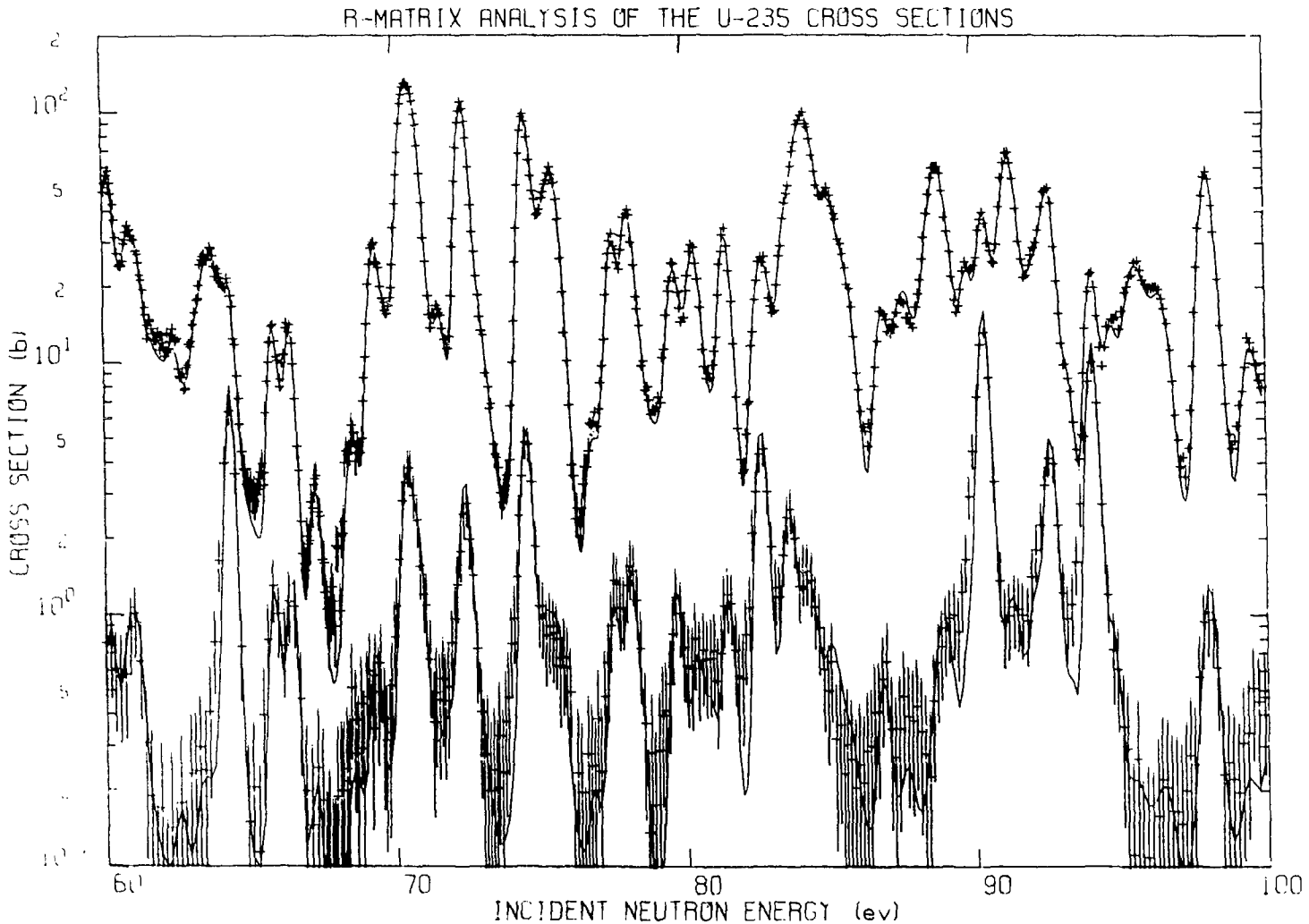
Reference	Energy range used in the analysis	Measurement characteristics
Gwin *et al.*[7] (1984)	0.01 to 30 eV	Fission at 22 m
Weston and Todd[8] (1984)	14 to 100 eV	Fission at 18.9 m
Blons[9] (1973)	17 to 100 eV	Fission at 50 m; sample cooled to 77K
de Saussure *et al.*[10] (1967)	0.4 to 100 eV	Fission and capture at 25.5 m
Perez *et al.*[11] (1973)	8 to 100 eV	Fission and capture at 40 m
Spencer *et al.*[12] (1984)	0 to 1 eV	Transmission at 18 m. Samples of 0.001468 atom/b
Harvey *et al.*[13] (1986) cooled	0.4 to 68 eV	Transmission at 18 m. Samples to 97K. Samples of 0.002343, 0.032808 atom/b
Harvey *et al.*[13] (1986)	4 to 100 eV	Transmission at 80 m. Samples cooled at 97K. Sample of 0.002343 atom/b
Moore *et al.*[4] (1978)	1.6 to 100 eV	Separated spin states fission data

FIGURE CAPTIONS

Figure 1. Transmission through samples of ^{235}U of 0.002335 at/b (upper curve) and 0.03269 at/b (lower curve) between 60 and 100 eV. Solid lines were computed with resonance parameters of our evaluation. Data from Harvey *et al.*[13]

Figure 2. Fission and capture cross sections of ^{235}U between 60 and 100 eV. The solid lines were computed with resonance parameters of our evaluation. Fission data from Weston and Todd;[8] capture data from de Saussure *et al.*[10] The capture cross sections (lower curve) are displaced by one decade for clarity.


R-MATRIX ANALYSIS OF THE U-235 CROSS SECTIONS
TRANSMISSION
0.9
0.6
0.3
0.0
60
70
80
90
INCIDENT NEUTRON ENERGY (ev)


R-MATRIX ANALYSIS OF THE U-235 CROSS SECTIONS
CROSS SECTION (b)
INCIDENT NEUTRON ENERGY (ev)
60
70
80
90
100